

Title: Saving Cape Hatteras: Weathering and Erosion project

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Grade Level: 5th

Integrated Content Areas: Science, Technology, Engineering, Math, Literature, Writing

Amount of Time Needed: 90 to 120 Minute Block of Time or two Days of 45 to 60 minute classes.

Materials:

- *Stones or tiles (craft stores offer ceramic tile pieces that can be used)*
- *wooden blocks (1" thick) (available from craft stores)*
- *Tongue depressors*
- *Toothpicks*
- *Coffee stirrers*
- *Pipe cleaners*
- *String*
- *tape*
- *Marker pen (sharpie—preferably one per group)*
- *Pebbles (or black beans or other small, round item)*
- *Rulers (one for each group)*
- *Sand*
- *1 cup measuring container*
- *Large shallow container or tub with long sides (or stream table)(tin baking pans work well)*
- *Timer (optional)*
- *Water*
- *Informational books on beach erosion/reclamation*
- *Student Interactive Science Journal for recording observations*
- *Posters to display student evaluation of project—glue, tape, colored pencils...etc. for display*

***Teacher or volunteer will need to act as the store clerk. Students will have a total of 3 purchases available. The purchases are tracked by having each group write a check for their supplies. Students will measure and count supplies while “clerk” verifies. Supplies are best set up on a science table—apart from the designing areas.*

Prerequisite Knowledge:

Using informational text, textbook, and nonfiction literature, students will identify weathering and erosion processes. Students will also identify prior knowledge of human technology and intervention in the control of destructive and constructive processes. Terms students should be familiar with include erosion and weathering (as it relates to water and wind), waves, destructive process, constructive process, jetty, sea wall, beach nourishment, beach reclamation.

Targeted Standards:

S5E1. Students will identify surface features of the Earth caused by constructive and destructive processes.

a. Identify surface features caused by constructive processes.

- Deposition (Deltas, sand dunes, etc.)

Identify and find examples of surface features caused by destructive processes.

- Erosion (water—rivers and oceans, wind)

c. Relate the role of technology and human intervention in the control of constructive and destructive processes.

Examples include, but are not limited to

- Seismological studies,
- Flood control, (dams, levees, storm drain management, etc.)

- Beach reclamation (Georgia coastal islands)

S5CS5. Students will communicate scientific ideas and activities clearly.

- Write instructions that others can follow in carrying out a scientific procedure.
- Make sketches to aid in explaining scientific procedures or ideas.
- Use numerical data in describing and comparing objects and events

S5CS3. Students will use tools and instruments for observing, measuring, and manipulating objects in scientific activities.

- Choose appropriate common materials for making simple mechanical constructions and repairing things.
- Measure and mix dry and liquid materials in prescribed amounts, exercising reasonable safety.

ELACC5RI4: Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade 5 topic or subject area.

ELACC5RI7: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.

ELACC5W8: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.

ELACC5W9: Draw evidence from literary or informational texts to support analysis, reflection, and research.

ELACC5SL4: Report on a topic or text or present an opinion, sequencing ideas logically and using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.

MCC5.NBT.7 Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.

MCC5.MD.1 Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems.

Engage and Explore: Activating Strategy --small groups of about 4 students each.

(teacher role: generate interest and curiosity, raise questions, assess current knowledge while guiding and pacing the process.

Student role: ask questions, create beach system, collect data, show interest)

- Create a beach environment in a tin pan with sand and water.
- Using a measuring cup, add 3 cups of clean sand to one end to stimulate a beach.
- Fill the pan with approximately 2.5 cm of water. (The sand will soak up some of the water, so pour slowly)
- Use the Sharpie Marker and draw a line along the edge of the pan to show where the sand and water meet.
- Take the measurements of the length and width of your beach in centimeters, and the length and width of your ocean in centimeters. Decide on a scale that will enable you to draw your beach into your Science Notebook. Convert the measurements and using interactive science notebook, sketch Beach Profile and label it, beach 1. (Use your measurements to write a detailed caption for your beach.)
- Place soaked sponge in end of the pan opposite the beach.
- Create small waves by pressing down on the sponge for 2 minutes. The waves should be just large enough to move the sand a little bit. Observe what is happening.
- Measure any changes to your beach. Be sure to convert this measurement to match your scale. Reflect on how the beach has changed after these small waves.

9. Sketch the beach profile, and label it beach 2. Write a caption describing what you have observed. (After small wave action, the beach erosion measured..., I observed...)
7. Leave new beach in place, but now lift and lower the edge of the sponge rapidly to create large waves for 2 minutes.
8. Observe, measure, reflect, and sketch Beach Profile 3, adding a caption to explain what you have observed.

Explain-small group :

(teacher role: ask for evidence or clarification on specific topics, remind students of previous experiences, encourage students to define or clarify thoughts, provide specific vocabulary where needed. Student role: listen to each group member and record additional information, consider problems and solutions to model, recall vocabulary when evaluating EQ, explains concepts learned, uses previous experiences to explain and elaborate concepts)

Using a target thinking map, students will center the words Beach Erosion in a target. Write the essential questions on the outside of the poster and tell students that these are a guide for helping them brainstorm. Each student, after choosing a colored pencil (none should be the same) will take a turns writing down one thing they know about beach erosion in the second circle. These written ideas are to be generated from the thoughts and comments of other members of the group. These ideas should be based on prior knowledge from previous lessons and observations from activating strategy. Students will continue to add to the list, one idea at a time as the brainstorming session continues. The 3rd square is for the teacher and student to brainstorm and list vocabulary words that coincide with the lesson, these are to be listed on the board or chart paper.

- How do waves cause coastline erosion?
- What engineering solutions protect coastlines?

Elaborate: small group

(teacher role: observes students to apply scientific concepts, skills, and vocabulary to a real world situation, reminds students of alternate use of materials, guides students to see possible problems with design and construction, encourages students to examine multiple solutions by thinking outside the box Student role: applies learned concepts to real world situation, demonstrates and understanding of constructive and destructive forces, uses previous information to ask questions and create design, records observations and supply list, and expense sheet, listens critically to the thoughts and ideas of other team members, proposes solutions, proposes possible obstacles to design, makes decisions about design and construction)

Using Power Point, introduce the engineering problem. Allow groups approx. 10 minutes to discuss the problem and possible solutions.

Review the “Elaborate” slides—students will view all slides, then be guided through each of the following phases planning, purchasing, constructing, and testing phases.

Slides to review:

job listings,

Tracking spending,

Calculating data in science journal,

30 minutes, \$3,000, and the materials to save the Lighthouse.

ROLE	RESPONSIBILITY
ARCHITECT	DRAWS DESIGN, MEASURES AND RECORDS ANY DATA COLLECTED DURING TESTING, CALCULATES THE DATA (ADDING AND MULTIPLYING), UPDATES DESIGN
TREASURER	TRACKS SPENDING, WRITES CHECKS (limited to 3 visits to the store) AND KEEPS ACCOUNT BALANCE, MAKES SURE SAFETY PROCEDURES ARE FOLLOWED, NOTIFIES TEACHER OF BROKEN OR MISSING MATERIAL
CONSTRUCTION ENGINEER	BUILDS THE STRUCTURE (MAY HAVE HELP FROM THE PROJECT MANAGER), CONDUCTS THE TESTS, OR ASSIGNS JOBS FOR THE TEST.
PROJECT MANAGER	MUST KEEP AN ACCURATE COUNT OF NUMBER OF WAVES DURING EACH PHASE, OBTAINS AND MANAGES BUILDING MATERIAL, MAKES SURE ALL MATERIALS ARE PROPERLY CARED FOR, MAKES SURE GROUP MEMBERS CLEAN UP AREA , IS RESPONSIBLE FOR ASKING TEACHER QUESTIONS

RULES FOR USE OF MATERIALS:

1. You will be given 3 checks and purchase orders for materials
2. Your total budget is \$3,000.
3. Do not mistreat your materials.
4. You must use only the materials your team purchases in class. You may not borrow, or add to the materials.

PROCESS:

1. Choose a name for your engineering company.
2. Brainstorm and design a drawing or blueprint for your solution.
3. Purchase the materials for your solution.
4. Construct your solution. Be careful not to waste or damage your materials. Keep your area clean.
5. Test your solution for 3 minutes with normal and heavy waves.
6. Prepare for a brief presentation of your solution to the group.

Planning Phase: **use the following rubric to help students with design prior to construction. Students are required to show the teacher their design before construction may begin.

TABLE 1 Rubric for Assessing Student Work and Participation

Category	4 Excellent	3 Acceptable	2 Needs improvement	1 Unacceptable
Plan	Plan is neat with clear measurements and labeling for all components. Construction may begin.	Plan is neat with clear measurements and labeling for most components, teacher may make a suggestion, but construction can begin.	Plan provides some measurements and labeling for components, but must be revised before construction can begin.	Plan does not show measurements clearly or is otherwise inadequately labeled. Plan must be corrected before construction may begin.

Purchasing Phase: In the purchasing phase, students use mathematics skills and problem solving to purchase materials that will both allow them to construct a representation of their design that falls within their materials budget. Students will work within a \$3,000 budget. They will have 3 checks that they can use to purchase supplies. Students must plan ahead and make appropriate purchases. After the third check is used, students may not return to the store for additional supplies.

Construction Phase: After or while purchasing their building materials and renting their equipment, students can begin to construct their design. The teacher should circulate around the room and ask each group to discuss how their design will withstand heavy storm waves, where sand that is eroded will be deposited, how their design will protect the lighthouse.... This prompting will help students stay on task and focused. Students can alter their design at anytime during the construction phase; however, they must account for any changes in their design or supplies list by completing a final version of their building design in their interactive science journal.

Testing Phase: After constructing their design, students will determine if their design is sturdy enough to present to the city council in charge of the Cape Hatteras Lighthouse Rescue. While conducting their test, students will gather data to present to the City Council. Evidence should be accurate and students should be able to refer back to the evidence in order to evaluate their design. At this stage, students will hopefully gain insight into what scientists and engineers do in the real world as they continually work to improve their designs based on criteria and budget constraints.

Objectives: (I can statements) (teacher questions to generate knowledge and correct misconceptions)

I can apply my knowledge and understanding of earth's constructive and destructive forces within a real world scenario. (Have you experienced waves before? What happens to leaves and dirt that are in the street when it rains? When is water most powerful? Describe for me what you have experienced with rain, waves, oceans, creeks...)

I can design and create a model of a beach environment by defining and keeping data on the system. (What measurement system would be easiest to use? How will you convert this measurement into a smaller scale that you can use to draw your system? What words can you use to describe what you observe? What would make this system more realistic?)

I can identify both constructive and destructive forces that shape the earth's surface. (How can water break rocks apart? Why do some places have more weathering and erosion than others? Is weathering a constructive or destructive force? Are waves constructive or destructive? What is deposition? Look at your model; can you point to areas of constructive forces? Destructive forces?)

I can explain how earth's constructive and destructive forces change and create surface features. (What features would you add to this system to make it more realistic? What landforms do you usually find on a beach? How are they created?)

I can apply my understanding of weathering agents and processes that are involved in creating a variety of landforms.

I can describe how scientists use observations and evidence from their models to gain knowledge, develop theories, and learn of earth's constructive and destructive processes. (Can you think of a situation where a scientist might create a model like this? What other things could be used to create your system? How does water carry rocks and sand? What questions do you have that this model does not answer?)

I can predict why some places will have more weathering and erosion than other places. (Did you notice any differences in the water when you created small waves compared to when you created storm waves? What effect does wind have on a beach?)

I can evaluate the use of technology and man-made structures to help control earth's forces. I understand that these measures are only temporary – eventually these will also succumb to earth's forces. (What kinds of man-made

structures used to prevent erosion have you seen? How long do you think it would take to erode a pile of sand in your system? Which type of rock do you think stands up better to the action of waves?)

I can apply mathematical knowledge to follow a budget. (How will you determine the number of items you will need? What rules do you apply when using decimals to add or multiply? Will it be easy or hard to stay within your budget?)

I can provide leadership to my group by thoughtfully organizing my assigned duties and providing focus and direction. (What is your job? What part of your job was easy? What part of your job was not easy? How did you encourage your group to design the best erosion prevention project they could?)

I can critique our design, looking for good points and not so good points. (How did your design stand up to the storm waves? What helped/hurt it? Did you notice anything new while you were testing your design? Did this lead to an improvement? What improvements could you make?)

Vocabulary:

weathering, erosion, continental drift, ridge, trench, fault, plate (tectonic), crust, mantle, tsunami, deposition, sediment, landform, beach nourishment, jetty, sea wall, coastline, wave

Evaluate: (20 Minutes)

(teacher role: observe and assess students as they apply concepts to real world problem, allow students to assess their own learning by critiquing project and design, asks open-ended questions, Student role: demonstrates understanding of constructive and destructive processes, elaborates upon the use of technology and construction to help slow down erosion process, provides explanations for results, answers questions using data and observation, refers to evidence to help answer open-ended questions, evaluates their own personal knowledge and progress toward understanding the concepts, offers explanations for results based on prior knowledge and experience)

Groups will be given a poster to display their project, materials, budget, their design, their data, and their evaluation of their project. This display will help evaluate student understanding of constructive and destructive processes, as well as the role of humans engineering and technology on a coastline. Students will answer open-ended questions by using observations, and evidence from the data collected as well as their experience during the trial phase of their design. Students will evaluate their design by suggesting improvements based upon their observations during testing.

Scoring Rubric for Cape Hatteras Lighthouse Poster/presentation

4 point response (A)	The poster includes a company name, design plans, budget, supplies, complete definitions of weathering and erosion with clear descriptions of how waves contribute to the destruction and construction of the beach around the lighthouse, an accurate explanation of why they chose their particular design, an accurate explanation of the changes that occurred during testing (deposition, erosion...), a comparison to the real world lighthouse, and reasons that their company should be chosen to complete the project.
3 point response (B)	The team demonstrates a basic understanding of the concepts of weathering and erosion but miss an important point or two about the processes. The poster is missing one or two required elements.
2 point response ©	The team demonstrates little understanding of the concepts of weathering and erosion along a coastline. The poster is missing several required elements
1 point response (D/F)	The team demonstrates no understanding of the concepts of weathering and erosion along a coastline. The poster is missing most of the required elements.

Differentiation: Grouping of the students is one way to differentiate during this lesson. Students could be grouped based on level of instruction, or students could be grouped randomly. Due to the fact that most science lessons are taught with a wide variety of levels of learning it would be best to group students in a way that the different levels of learning could be dispersed throughout the groups. Groups that need extra support can be given the opportunity to use non-fiction text as a resource. Groups that have difficulty with the budget can be presented paper currency to spend instead of checks.

Extension:

Writing: students can create an advertisement for their company, or write a persuasive essay stating why their company should be chosen for the project. Students could create a daily journal of a person growing up on Cape Hatteras. They journal can describe the changes that would occur to the beach. Students can use technology to look up major storms that effected the area.

Technology: students can research other national monuments and describe the effects of weathering on the structure.

Social Studies: students can create a map of the Outer Banks where the Cape Hatteras Lighthouse is located, or they can create a map of the Georgia Barrier Islands. (two students could complete both projects and compare them). Students can research the sinking of Civil War ships off the coast.